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Biometrics and Eugenics: Past, Present, and Future

Are our fates really in our own hands? Are we truly the authors of our own lives? Or are our destinies predetermined, encoded in our genes? Do the essences of our beings really reside in nothing more than a sequence of A's and T's and G's and C's? As such, the age-old "nature versus nurture" debate continues to dominate both philosophical and scientific conversation into the present-day. However, both throughout time and across the globe, an affinity for one over the other has shifted back and forth; the global eugenics movement of the late nineteenth and early twentieth centuries was an era in which the "nature" argument won the favor of the world's societies and governments. The field of genetics was still young and developing when the eugenics movement found a socio-political foothold and gained notable traction, especially in the global west. Thus, little to no empirical evidence existed to support the claim that was the foundation of the eugenic ideology: that everything from personality to moral character to intelligence is a product of biological inheritance. Even so, this reality did not stop eugenicists from trying to back their pseudoscientific theories with faulty math and statistics in the form of biometric analysis. Modern-day biometric technologies evolved from these early forms of biometry and often create more harm than good in perpetuating the eugenic legacy of discriminating against already marginalized groups of people.

Looking at current biometric technologies from a historical perspective helps us understand that biometrics were as innovative in the nineteenth century as they are today

(Miller). To first assign a definition to biometrics, biometry refers to the "field of development of statistical and mathematical methods applicable to data analysis problems in the biological sciences," or in layman's terms, the scientific practice of measuring all components of biological entities, most commonly human anatomy and physiology (International Biometric Society). While biometry has been around for hundreds, even thousands of years, biometry as a scientific practice began with Sir Francis Galton, also known as the father of eugenics, in the late nineteenth century. Galton coined the term eugenics and defined it as "all influences that tend in however remote a degree to give to the more suitable races or strains of blood a better chance of prevailing speedily over the less suitable than they otherwise would have had" (Stinson). He invented the method of fingerprint mapping to distinguish people based on fingerprints, which is still in extensive use today from unlocking iPhones to verifying identity by governments and law enforcement, as well as numerous other contributions to biometrics and statistics (Ball). Biometrics were an intrinsic element of the eugenic movement which sought to categorize and rank people based on physical traits and connect those physical traits to personality and character. In addition to the contributions of Francis Galton, many other biometric techniques were developed by British anthropologists and statisticians in the mid-to-late nineteenth century in support of the growing eugenics movement and the associated boom in eugenics research, which police departments of the time adopted (Miller). For example, in 1904, a national concern for an overall decline in public health in the United Kingdom led a government committee to conduct a widespread anthropomorphic survey to measure the bodies of British citizens to determine the cause of "physical deterioration" (Miller). The anthropologists who were consulted as experts on the survey design had the ulterior motive of using the anthropometric survey and the government's resources to further eugenics research, racially classify inhabitants of the UK,

and advocate for anti-Semitic immigration policies, which is all to say that "biometric systems relate to the politics of inclusion and exclusion" (Miller).

Out of biometrics emerged the pseudoscience of phrenology founded by German physiologist Franz Joseph Gall in the early nineteenth century, which asserted that "the conformation of the skull [was] indicative of mental faculties and traits of character" (Britannica). As was the case with most biometric technologies of the time, phrenology sought evidence to confirm the researcher's pre-existing notions regarding race and gender rather than forming conclusion based on the entirety of the collected evidence. Before its postulations were disproven and dismissed as pseudoscience, phrenology enjoyed immense popularity in the nineteenth and twentieth centuries, especially amongst eugenicists who used phrenological analysis as justification for eugenic policies, supposedly proving that already marginalized groups were inherently inferior, based solely on skull size and shape alone. This popularization of phrenology aligned with the struggle in the United States in the mid-to-late nineteenth century to justify the continuation of slavery as a pushback against an abolitionist movement that was gaining significant traction and to justify the brutal slaughter and displacement of indigenous populations by white settlers ("Phrenology"). Physicians used phrenology to attempt to prove that people of African were rightfully slaves by studying the skulls of many different races and ethnic groups and concluded (really a gross generalization) that the skulls of people of African descent suggested a "tamableness" that suited them to be slaves, requiring them to "have a master" ("Phrenology"). This horribly misinformed view of black people as inherently inferior fostered the prolongation of slavery as well as the systemic racism that overtly lingers in the United States to this day. Regarding how phrenology was used against indigenous peoples, one article cited that indigenous peoples were naturally "adverse to cultivation, slow in acquiring

knowledge" ("Phrenology"). This faulty use of "science" to support the exploitation of people of color promoted the perpetuation of racial oppression and the warped idea of the biological origin of race, which is the same consequence of the application of many biometric technologies today.

Stanford Institute for Human-Centered AI Fellow Michelle Spektor, in an interview about her research into the history of biometrics and how this history informs the current expanded use of biometrics by governments for the purpose of identifying citizens, explains that "one common thread through the history of biometrics is the belief that biometric measurements say something about individual identity," a belief that persists into the present-day (Miller). Biometric techniques are being used just as they were in the heyday of the eugenic movement, only this time wrapped up in fancy algorithms, software, and artificial intelligence. The implementations and applications of biometric systems today may be ushered by the modified belief that "biometrics are simply accurate tools for verifying identity," but the advent of biometrics out of nineteenth century eugenics research shows researchers measuring the human body with the intention of categorizing identity (Miller). In recent years, an increasing number of AI technologies have been designed to do exactly what the biometrics of the early twentieth century attempted to do: find associations between physical appearance and character traits. Even though these AI algorithms only reinforce pre-existing human biases and assumptions about race, gender, age, and disability in relation to the body, they have even more power than the misleading math and statistics of the early days of biometrics to fool people into believing that there is an actual genetic correlation between personal appearance and more abstract components of a person's character, such as intelligence, personality, and relative morality. This type of technology is dangerous in that it assumes that people are born with their being set in stone,

which is not the case at all, and does not account for social factors that contribute to intellectual and moral development (Stinson).

Recent applications of these machine-learning algorithms appeal to a niche market of governments and privately owned companies who seek to possess more power over citizens and clientele, respectively, by promising the ability to obtain all sorts of information about a person from their appearance alone (Stinson). One application of this technology hails from Stanford University where researchers have developed a "gaydar" algorithm that can allegedly differentiate the faces of gay and straight individuals using the biometric of facial recognition. The researchers cited prenatal hormone theory as the foundation for the efficacy of their algorithm, which states that exposure to androgens in utero may determine sexual orientation and that exposure to different levels of hormone generally may result in gender atypical faces (i.e., suggesting a biological explanation for sexuality) (Stinson). There are many issues with the use of this theory to resurrect the phrenology of yore. Firstly, the Stanford researchers are conflating gender and sexuality, which are far from being one and the same. Gender refers to your gender identity, which does not always correlate with biological sex. Sexuality has everything to do with to whom you are attracted and nothing to do with gender. Secondly, prenatal hormone theory is an unproven, highly contested claim within the medical field, so the fact that the Stanford researchers built an entire biometric around it is astonishing. Lastly, the motivation the researchers indicated for even building the algorithm in the first place was to "expose a potential privacy threat" but failed to specify the perceived privacy threat for which they are preparing. In other words, this "gaydar" is a solution to a nonexistent issue and exists only to confirm the researchers' own assumptions about gay people. It is indicative of a eugenic mindset that

involves othering those who do not fit a society's definition of the norm, heterosexuality being the norm in this case.

Other phrenological applications of modern-day biometric technologies range from using artificial intelligence that supposedly detects the personality traits of job candidates based on facial expressions to using surveillance cameras in areas populated by majority ethnic and racial minorities to track them in both the United States and China to schools installing camera systems that penalize students for not paying attention in class based on facial movements and micro-expressions (Stinson). In addition, some universities have implemented proctoring algorithms for online exams, so not only do students have to worry about performing well on the exam but also now they must maintain the countenance of a student who is not cheating so that the algorithm does not flag them. These proctoring algorithms have been known to falsely accuse students with disabilities who move their bodies in atypical ways as well as black students whose faces the facial recognition algorithm cannot even detect (Stinson). While many facial recognition algorithms boast high accuracy rates of over ninety percent, this success rate does not hold up when these technologies are used on people of color and women. Research has shown divergent error rates for these demographics, "with the poorest accuracy consistently found in subjects who are female, Black, and 18-30 years old" (Najibi). A final example of modern-day biometric technologies reinventing archaic methods comes from Shanghai Jiao Tong University in China where AI researchers Xiaolin Wu and Xi Zhang trained an algorithm that can allegedly identify criminals based on face shape alone with an accuracy of 89.5 percent (Stinson). Wu and Zhang borrowed directly from and built a more a high-tech version of the "photographic composite method" developed by none other than father of eugenics, Francis Galton, which involved

"overlaying faces of multiple people to find the features indicative of qualities such as health, disease, beauty, or criminality" (Stinson).

The links of all the recent applications of biometric machine-learning applications outlined thus far to phrenology and subsequently eugenics are undeniable as is the outright eugenic nature of some of the applications of this technology. To reiterate, the aim of eugenics is to "improve" humanity by encouraging reproduction amongst those deemed fit and discourage it amongst those deemed unfit. For example, the United States and China's unlawful surveillance of ethnic and racial minorities has the clear objective of denying opportunities to these groups who are deemed unfit. More specifically, in the United States, Project Green Light (PGL), a model surveillance program enacted in 2016, sanctioned the installation of high-definition security cameras throughout Detroit, Michigan, and the distribution of these stations is disproportionately high in areas with majority black residents (Najibi). The data from these surveillance cameras is streamed directly to the Detroit Police Department where it is run through facial recognition technology and tested against criminal databases, state identification photos, and driver's licenses (Najibi). A critical analysis of PGL in 2019 revealed that "'surveillance and data collection was deeply connected to diversion of public benefits, insecure housing, loss of employment opportunities, and the policing and subsequent criminalization of the community members that come into contact with these surveillance systems'" (Najibi). The imagined noble intentions of these technologies are ultimately overshadowed by their tendency to lead to the same predictable outcome: false positives for already marginalized communities, resulting in a denial of rights and opportunities for these groups as well as a perpetuation of racial inequality.

Diving into the nitty-gritty technical component of how machine-learning algorithms is trained provides insight into why so-called neutral technology only exacerbates pre-existing social inequalities. AI algorithms are trained on sample datasets that act as a blueprint for the purpose the AI needs to serve and for what it needs to look. However, when these datasets are limited due to human biases and oversight, the AI can only do so much with the models it is given, which results in flawed datasets that limit functionality of the AI for underrepresented groups, such as gender minorities and people of color. For example, in the AI study of criminality in China, the data were gleaned from both mugshots taken by law enforcement for convicts versus professional photos found on the Internet for non-convicts, two very different sources (Stinson). Photos that people willingly post to the Internet, of course, will show them with facial expressions, clothing, and in life circumstances far different from those of mugshots to which people do not consent, which alone can account for the algorithm's ability to differentiate amongst groups (Stinson). This same logic can be applied to Stanford's "gaydar" algorithm research in that an obvious explanation for why the algorithm can differentiate between the photos of gay and straight people is that the study pulled the dataset photos on which researchers trained the algorithm from dating sites. On these dating sites, people tend to be dressed, posed, and made up differently; in addition, varying camera angles can alter one's true face shape (Stinson). This methodology also perpetuates stereotypes about a person's appearance reflecting their sexuality and promotes the heteronormative idea that sexuality must be performed. The researchers of the criminality AI themselves admitted that conflating court convictions with criminality was a "serious oversight" on their part and view this oversight as an empirical flaw. Using photos of convicted criminals and excluding photos of those who were cleared of charges "introduces a statistical bias that skews the results" (Stinson). These Shanghai

University researchers later backtracked and claimed that their study was intended “for pure academic purposes” (Stinson). Even if their intentions had been pure, their blatant lack of awareness that their technology only reinforces preexisting biases rather than empirically determining whether a person is genetically a criminal or not speaks volumes regarding a larger issue in the tech industry of prioritizing technological advancement itself over the social ramifications of the technology.

Let us also consider those cases in which biometric algorithms are made equitable, i.e., they are trained on sufficiently diverse datasets. Another key source of biometric machine-learning algorithms further marginalizing already marginalized groups lies in the utilization of these technologies. Once again looking at the criminal-detecting AI, the researchers on this project never address the fact that being convicted of a crime itself is dependent upon impressions of police, judges, and juries; hence, intense over-policing of certain communities and unequal access to legal representation skew the dataset (Stinson). There exist clear differences in the appearances of people who are arrested and convicted and those who are not, which all boils down to racial and colorist biases. For example, discriminatory law enforcement practices in the United States result in disproportionately more arrests and incarcerations of black Americans for minor crimes than white Americans. Consequently, “black people are overrepresented in mugshot data, which face recognition uses to make predictions” (Najibi). This overrepresentation, in turn, creates a feed-forward loop: racist policing strategies lead black people being arrested more frequently, and subsequently being subject to more surveillance in the future (Najibi). The criminality AI researchers, Wu and Zhang, maintain their assumption that “’being a criminal requires a host of abnormal (outlier) personal traits,’” suggesting that a disposition for criminality is inherent—a eugenic assumption—rather than the culmination of

several environmental factors, such as poverty or abuse, or a label applied by people in power to exert social control over the "unfit" (Stinson). The concept of criminality itself is entirely subjective and only stigmatizes overpoliced communities. In addition to having a high accuracy rate, the criminal-detecting algorithm also somehow has a high false positive rate, meaning that the face of a person who has never been convicted of a crime resembles that of a person who has: "more than ninety-five percent of people it classifies as criminals have never been convicted of a crime" (Stinson). Thus, racial biases in the criminal justice system lead to a gross overestimation of criminality among marginalized communities by biometric algorithms, continuing the eugenic narrative by over-surveilling these communities, which "threatens rights including privacy, freedom of expression, freedom of association and due process" and "induces fear and psychological harm, rendering subjects vulnerable to targeted abuses, as well as physical harm, by expanding systems of government oversight used to deny access to healthcare and welfare" (Najibi). In other words, this technology aids in the effort to eliminate the "unfit."

Despite the many ways in which biometric technologies have perpetuated the eugenic legacy of distinguishing the "fit" from the "unfit," biometric technologies have uses that are not phrenological in nature. In fact, biometrics are a staple (some might argue, a necessity) in healthcare as they solve two main problems: "patient matching and patient identification" (Alkhaldi). A person's fingerprint, iris, voice, or other biometrics cannot be stolen or forgotten like a password and are, therefore, a more reliable method of identification. Biometrics differ from other authentication methods in that they are inherent to the user, meaning that they are not easily compromised by social engineering scams, for example (Owen-Jackson). All one needs is their body to identify themselves, so they are easier and more convenient to use than more traditional forms of identification (Alkhaldi). Manual methods of identification lead to an

eighteen percent average duplicate record, which comes out to 1.5 million dollars' worth of annual losses in claim denials, so, in the long term, biometrics are cheaper forms of identification that eliminate these expensive duplicates (Alkhaldi). Biometrics are also a suitable identification method for special needs individuals, especially for those who are illiterate who may not be comfortable revealing that they cannot write with traditional identification methods (Alkhaldi). With these advantages in mind, biometrics have the potential to be more inclusive in terms of increased accessibility and affordability for many.

This discussion of some of the benefits of biometrics begs a couple questions: Do the benefits of biometrics outweigh the drawbacks? And if not, how can they be made to be more equitable and deviate from their eugenic parentage? At an algorithmic level, the drawbacks of biometric technologies outweigh the benefits in that even the biometrics that are simply used to verify identity still have many issues recognizing people with darker skin tones and feminine features due to biometric AI algorithms being trained on narrow datasets that do not represent a sufficiently diverse array of peoples. However, at an application level, the benefits versus drawbacks question turns into more of a question of how biometrics should be used in ways that will not aggravate existing human biases that harm already marginalized groups. Those applications of biometrics that reinvent phrenology should not continue to be developed as they do more harm than good in their mission to classify people based on physical characteristics and making arbitrary assumptions about people on these grounds. Eugenicists active at the height of the eugenics movement ultimately failed to find facial features or skull shapes and sizes that predisposed a person to a particular moral character, and psychologists of the time who studied the potential genetic influence of intelligence had to cleverly but dishonestly collect and present their data in a way that made it seems as if they had found genuine connections between skull

size, race, and IQ when they in fact had not (Stinson). Complex personality traits, such as criminality, are "exceedingly unlikely to be genetically linked to appearance in such a way as to be readable from photographs," and if they were genetically linked, they "would have to be determined to a significant extent by genes rather than environment" (Stinson). The larger influence of environment will dilute any weak genetic factors if any exist (Stinson). A more likely explanation for any association between appearance and moral character is that one's appearance influences how they are perceived by society, which in turn prompts society to treat that person a certain way, which in turn drives a person to behave a certain way.

In conclusion, to do away with biometrics entirely would be to terminate uptake of a technology that does have a handful of valuable uses; however, the applications of biometrics should be closely monitored and regulated: "Some commentators argue that facial recognition should be regulated as tightly as plutonium, because it has so few nonharmful uses" (Stinson). Not all hope is lost for biometrics. Several courses of action are being pursued to address the inequities that biometrics, especially facial recognition, inflame. Some solutions that target algorithmic performance include training algorithms on more diverse datasets, "as standard training databases are predominantly white and male;" establishing image quality standards so that cameras are optimized to capture darker skin tones; and regular and ethical auditing of biometric technologies to ensure that they function for all identities, especially intersecting ones, and hold companies accountable (Stinson). Regarding the issue of how to curtail the weaponization of biometric applications against minorities, legislative action can be taken to monitor the use of biometrics, especially facial recognition where over-surveillance is a concern. Companies and organizations that produce these technologies themselves must be held accountable by lawmakers educated in racial literacy to be transparent in the development and

testing of their technologies; address biases and evaluate potential applications in their technologies before distribution; and assess algorithmic training, accuracy, and data privacy in the testing of their technologies (Najibi). Software engineers are not exempt from remembering the old proverb, “Those who do not learn history are doomed to repeat it.” They carry the immense responsibility of ensuring that the eugenic practices of the past stay buried and do not resurface in an age in which technological advancement will allow it to return more powerful than ever before.

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